THE DEPARTMENT OF ENERGY'S BUDGET REQUEST FOR FY 1999

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OPENING REMARKS

Mr. Chairman and members of the subcommittee, I am the Director of the Lawrence Livermore National Laboratory (LLNL). Our Laboratory was founded in 1952 as a nuclear weapons laboratory, and national security continues to be our central mission.

Livermore is committed to maintaining confidence in the U.S. nuclear stockpile and to stemming and countering the proliferation of weapons of mass destruction. Our goal is to apply the very best science and technology to enhance the security of the nation and make the world a safer place.

INTRODUCTION

In a formal sense, the Stockpile Stewardship Program began with the Record of Decision for the Programmatic Environmental Impact Statement in December 1996. In practical terms, the nation's program to maintain the safety and reliability of the nuclear weapons stockpile without nuclear testing has its roots in activities more than a decade old. The Stockpile Stewardship Program is off to a good start. We have formulated and started executing detailed program implementation plans. We have formed strong partnerships among the laboratories, the production facilities, the Nevada Test Site, and U.S. industry and universities. And, we have established new formal certification procedures and review processes to assure the nation that the stockpile continues to be safe and reliable. The Secretaries of Energy and Defense provided such assurances in the first and second annual certifications.

Significant technical achievements back up the annual certifications and prepare us for a future in which stockpile assurance will become an even greater challenge in the absence of nuclear testing. We are making considerable headway in developing a basis for understanding aging effects in weapon materials. We are effectively using our computational and experimental tools to address current stockpile issues. In addition, the first significant modification of a weapon, the B61-11, is entering the stockpile and the first program to extend the stockpile life of a weapon system, the W87 ICBM warhead, is making excellent progress. These successes to date provide a basis for optimism about the program's prospects for achieving its ambitious goals.

We are also proceeding on schedule with the construction of both the National Ignition Facility (NIF) at Livermore and the Dual Axis Radiographic Hydrodynamic Test Facility (DARHT) at Los Alamos and with the acquisition of more powerful computers—all crucially important to the long-term success of stockpile stewardship. This investment in the new experimental and computational capabilities is needed to assess weapon performance, assure the quality of refurbishment actions taken to extend the lifetime of weapons, and train the next generation of stockpile stewards.

Livermore scientists and engineers are using the first elements of our next-generation supercomputer to tackle difficult stockpile issues. The new machine, developed by IBM, is in the process of being upgraded to make it the fastest and most capable supercomputer in the world. Also this year, construction of the NIF began at the Livermore site. Through your support, nearly 42% of the total funding for the NIF project has already been authorized. The last of the major building construction contracts is to be awarded this month and procurement of special equipment has begun. This $1.2 billion, 192-beam laser facility will provide the means for investigating the thermonuclear physics of primaries and secondaries in nuclear weapons. The NIF schedule calls for an initial capability by the end of 2001 and project completion by the end of 2003.

The Stockpile Stewardship Program has greatly benefited from strong bipartisan support, effective integrated program planning and implementation, and the dedicated efforts of the many people in the program, who are working as a team and achieving significant technical accomplishments. To succeed stockpile stewardship requires continuing support and adequate investment over the decade it takes to implement the program. The budget request for FY 1999 provides $4.5 billion for next year’s activities.

Livermore’s national security responsibilities extend beyond stewardship of the U.S. stockpile. The proliferation of weapons of mass destruction (WMD)—nuclear, chemical, and biological—is a serious threat to national security. Regional instabilities continue to erupt, which, when coupled with the desire (stated or covert) of nation-states to acquire weapons of mass destruction, pose an increasing threat to national and global security. Threats also stem from surpluses in weapons-usable nuclear materials and WMD know-how residing in the former Soviet Union. In addition, the specter of WMD terrorism cannot be dismissed.

A multipronged approach is needed to counter these threats. The Department of Energy and its national security laboratories apply the expertise gained in their nuclear weapons work, together with their extensive experience in chemical and biological sciences, to support U.S. arms control and nonproliferation policy, analyze weapons activities worldwide, and provide technical capabilities to thwart WMD threats.

The three DOE national security laboratories (Livermore, Los Alamos, and Sandia) also work with the Department of Defense (DoD) to leverage the laboratories’ capabilities and provide long-term research and development support to meet future defense challenges. At Livermore, our efforts have been broadly based. We have provided support to the intelligence community, and we have contributed to the development of missile defense, new energetic materials, and computer tools for design and analysis. Efforts are under way to establish ways to further increase the effectiveness of the support provided to the DoD and make it even more responsive to critical needs.

STOCKPILE STEWARDSHIP

The DOE Stockpile Stewardship Program

The DOE Assistant Secretary for Defense Programs has led the Department, its three national security laboratories, and others in the weapons complex in the development of the Stockpile Stewardship Program. It is a program designed to ensure the safety and reliability of the U.S. stockpile in an era of no nuclear testing, no new weapon development, a production complex with reduced capacity, and an aging stockpile of fewer weapons and fewer types of weapons.

Confidence in the safety and reliability of the weapons is to be maintained through an ongoing and integrated process of stockpile surveillance, assessment and certification, and refurbishment:

- *Stockpile surveillance: predicting and detecting the effects of aging and other stockpile problems*. With fewer types of weapons in the stockpile and reduced capabilities and capacity in the production complex, we need to become more proficient at early detection and identification of precursors of potential problems so that we have adequate time for thorough evaluation and action before problems affect stockpile safety or reliability. Major efforts are under way to enhance surveillance capabilities.

  We are preparing detailed archives of existing test data and using very modern instrumentation to obtain even more precise physical data on stockpiled weapons for use as a baseline to identify anomalies in aging weapons as they occur. We are also improving the sensors and techniques used to inspect stockpiled weapons. In addition, we are developing a better understanding of how aging alters the physical characteristics of weapon materials and components.

- *Assessment and certification: analyzing and evaluating effects of changes on weapon safety and performance*. The Stockpile Stewardship Program includes a comprehensive set of activities to address issues that arise from stockpile surveillance and to evaluate the significance of observed and predicted aging processes. Assessments provide the foundation for formal certification of stockpile performance and refurbishment decisions. When modifications are deemed necessary, we must assess options for refurbishing or replacing specific warhead components as well as new production and fabrication processes and materials. Modification actions must then be certified.

  Assessments must be based on scientific and engineering demonstration to be credible. In the absence of nuclear testing, we rely on data from past nuclear tests as a benchmark, component-level experiments and demonstration, and advanced simulations for an integrated assessment of weapon performance and safety. This approach has enabled us to successfully address stockpile issues that have emerged to date. However, as the stockpile ages, we anticipate that more difficult assessment issues will arise. In addition, it is possible that, as in past cases, design and production flaws will be discovered in systems that have been in the stockpile for some time. These realities are driving the program’s investments in much more capable experimental facilities, such as the National Ignition Facility and the Dual Axis Radiographic Hydrodynamic Test Facility, and greatly enhanced numerical simulation tools developed through the Accelerated Strategic Computing Initiative.

- *Refurbishment: refurbishing stockpile weapons and certifying new parts, materials, and processes*. Weapon refurbishment is a particularly demanding challenge because we cannot rebuild many weapons components exactly as they were manufactured. In many cases, the materials or the manufacturing processes originally used are no longer available or are environmentally unacceptable. Production quality assurance must be provided by new assessment and certification processes that do not include nuclear testing.

The laboratories and plants are working closely together to integrate the development of replacement components with the development of new materials and manufacturing processes. To lower costs and environmental impact, refurbishment can make use of modern production technologies and incorporate major technical advances—such as in electronics—that have occurred since the weapons were first manufactured. Our focus is on technologies that are flexible and high quality (to provide defect-free production in a capacity-limited complex) and that use modern commercial methods wherever possible.

Integrated Program Management and Execution

Integrated program management and execution is critical to the success of the Stockpile Stewardship Program. The three major program elements—surveillance, assessment, and refurbishment—are tightly interconnected, as are the activities of the three laboratories, the production plants, and the Nevada Test Site. A detailed implementation plan, referred to as the "Green Book," specifies roles and responsibilities within the program and defines the capabilities needed for stockpile stewardship without nuclear testing. As a living document, the Green Book is undergoing its third revision this year. It is updated and improved as the laboratories and plants continue to refine comprehensive life-extension plans for each weapon system in the enduring stockpile. These plans integrate surveillance, assessment, and life-extension manufacturing activities for each weapon system, and (to the extent possible) time-phase all activities to balance the workload.

The Stockpile Stewardship Program entails substantial partnerships among the laboratories and between the laboratories and the production plants. It is an integrated effort requiring the special capabilities and the unique facilities at each site in the complex. Livermore has major responsibilities within the program. We are the design laboratory for the W87 and W62 ICBM warheads, the B83 bomb, and the W84 cruise missile warhead. Our nuclear weapon designs are in two legs of the strategic triad and, overall, comprise three of the eight weapon systems scheduled to remain deployed after the turn of the century. The Laboratory also operates for the integrated complex a number of state-of-the-art experimental and computer facilities that are essential for stockpile stewardship. In addition, as one of the two nuclear design laboratories, Livermore shoulders essential responsibilities in formal revalidation and certification activities for all nuclear weapon systems in the stockpile. In the absence of nuclear testing, revalidation and certification depend on formal review of the technical assessments performed by program personnel. The process is greatly strengthened through the use of expertise and capabilities at each of the laboratories and independent evaluations—often referred to as "peer review."

A Program That Is Well Under Way

In a formal sense, the Stockpile Stewardship Program is just over a year old. The Record of Decision for the Programmatic Environmental Impact Statement, which defines the architecture of the program, was issued in December 1996. In practical terms, the Stockpile Stewardship Program is well on its way, and progress to date provides a basis for optimism about the program's prospects for long-term success.

We have maintained the nuclear weapons stockpile without nuclear testing since 1992, when the United States entered into a nuclear test moratorium. President Clinton has since signed a Comprehensive Nuclear Test Ban Treaty aimed at ending nuclear explosive testing on a worldwide basis.

Three important factors have enabled us to meet the challenge to date. First, the weapons intended for the enduring stockpile all have good pedigrees—they went into the stockpile with blue chip credentials. To date we have seen no signs of catastrophic aging. However, vigilance is required because nuclear weapons age in very dynamic, not necessarily predictable ways. Both the difficult task of assessing an ever older stockpile and the new challenge of certifying refurbished weapons increase the complexity of stockpile stewardship as time passes.

Second, we have been able to meet the challenge because of the expertise residing in the technical staff—hands-on nuclear design, engineering, and test experience accumulated through the development of weapons now in the stockpile. But that experience base is also aging, so we are taking important steps to archive that experience and make prudent use of it while we have it. That includes working with the next generation of scientists and engineers to tend to the current needs of the stockpile and lay the foundation for the long-term program for stockpile stewardship.

Third, we have worked closely with Assistant Secretary Vic Reis and others in Defense Programs to design the overall program and provide the technical basis for its ambitious goals. We established what capabilities the program needs by when and worked throughout the 1990s to achieve enabling scientific and engineering advances. Steady technical progress on a number of fronts moves us closer to the long-term goals of the Stockpile Stewardship Program.

For example, we have made tremendous advances the development of fast, high resolution instrumentation and diagnostics, and associated experimental techniques. The advances enable us to obtain crucial information about the properties of plutonium from experiments at the Nevada Test Site. They make it possible for us to gather more revealing data from hydrodynamic tests. In addition, they open up possibilities for weapon science experiments using Nova and the National Ignition Facility that were not even contemplated a few years ago. Furthermore, advances in instrumentation are also critical for improved nondestructive methods for stockpile surveillance.

Finally, it is also important that the DOE has established as part of the Stockpile Stewardship Program new formal review processes for certification of weapon safety and reliability in the absence of nuclear testing. It is essential that judgments and decisions made by the stockpile stewards are credible among themselves, to DoD and other in the nuclear weapons community, and to the Administration and Congress. In February 1997, we completed the first annual certification of the stockpile for the President and were able to conclude that the nation’s nuclear weapons remain safe and reliable. We completed the second review in November 1997 with the same conclusion.

This certification is based on technical evaluations made by the laboratories and on advice from the three laboratory Directors, the Commander in Chief of the Strategic Command (CINCSTRAT), and the Nuclear Weapons Council. To prepare for annual certification, our laboratory collects and analyzes all available information about each stockpile weapon system, including physics, engineering, and chemistry and materials science data. This work is subjected to rigorous, in-depth review by managers and scientists throughout the program.

In addition to annual certification we have developed in consultation with DoD a dual revalidation process to examine in detail over a two to three year period each warhead design in the stockpile. The W76 warhead is the first system undergoing dual revalidation.

We are also establishing with DoD new procedures for recertifying weapons after life-extension refurbishment activities.

Stewardship Accomplishments—in Stockpile Surveillance

Our stockpile surveillance efforts focus on Livermore designs in the stockpile: the W87 and W62 ICBM warheads, the B83 bomb, and the W84 cruise missile warhead. They also build the scientific base and develop monitoring capabilities to better understand aging effects in all stockpiled weapons. Aging affects the physical characteristics of materials, and we must determine how these changes impact weapon safety and performance. With a better understanding of aging, our stockpile surveillance can be more predictive, making possible systematic refurbishment and preventative maintenance activities to correct developing problems.

Detecting and Modeling Corrosion in Nuclear Weapons

Modern nuclear weapons consist of precision manufactured components made from highly reactive metals such as plutonium and uranium as well as organic compounds. High explosives, adhesives, and various structural parts consist of organic materials. Many of these organic materials are very stable under benign conditions. However, material breakdown occurs from exposure to radiation, higher than normal temperatures, and gases that accumulate over time in a hermetically sealed weapon environment. These released gases are indicators of aging and they can corrode the highly reactive metals or affect the integrity of other organic materials.

Understanding the evolution of the gases in the free volume of a complex nuclear weapon and extrapolating the long-term consequences present challenges to our materials scientists. Significant progress is being made through a combination of improved detection capabilities and efforts to model corrosion in weapons on a computer. Working with the plants, we are using a newly developed technique for sampling evolved gases within stockpile weapons that is extremely efficient and does not require collecting a large gas sample. In a minimally intrusive way, the outgassed chemicals are collected and concentrated onto a “microextraction fiber.” The fiber is then examined to detect and analyze minute, complex chemical samples that may be signatures of degradation. We are using this inherently safe technique to analyze the complex mix of gases obtained from stockpile surveillance units.

Livermore researchers also are developing a computer model of the generation, transport, and reaction of materials in aging canned secondary assemblies (CSAs) in weapons. This model treats in detail the chemical properties of materials and their interaction with gases and other substances in the actual physical geometry of the CSA, including gaps between parts and materials. The model has successfully replicated the corrosion observed over time in test cases that include materials and geometric features that occur in weapon components. When thoroughly tested and validated, we will be able to use the simulation tool to predict the effective life of CSAs.

Experiments, Theory, and Modeling to Better Understand Plutonium

One of the major success stories of the Stockpile Stewardship Program is the significant improvement we are making in understanding of the properties of plutonium. This is a very important issue to us—we need to understand aging in plutonium and the effect of aging-related changes on the performance of an imploding pit of a stockpiled weapon. If remanufacture of plutonium parts is required, we must provide long lead times because of the complex’s limited capacity for plutonium operations.

Plutonium is a comparatively stable material in weapons; however, its properties are among the most complex of all the elements. To study the subtleties of plutonium, we in fact needed scientific approaches other than nuclear testing, where the explosion can obscure salient details. We combined advances in theoretical modeling of plutonium with the use of many advanced non-nuclear research tools, only recently technically feasible and increasingly made available through Stockpile Stewardship Program investments. These include various types of laboratory experiments to study the microstructure of plutonium, computer simulations of plutonium at the atomic and molecular scales, and in 1997, our first subcritical experiment at the Nevada Test Site to investigate the properties of plutonium shocked and accelerated by high explosives.

Working with colleagues at Los Alamos, we have also devised a strategy for carrying out accelerated aging tests to help us assess the performance of plutonium pits much older than those now in the stockpile. By using mixture of isotopes of plutonium different than that used in weapons-grade plutonium, we are able to create a “spiked” material that ages about 12 times faster than the plutonium in weapon pits. Once we verify that the “spiked” material behaves similarly to normal weapons-grade plutonium in other important respects, we will use it in accelerated aging tests to determine how properties that determine pit performance degrade over time.

In addition, experiments on Livermore’s Nova laser have demonstrated that the complex physics of primaries can be investigated using Inertial Confinement Fusion targets. We are able to measure material properties, such as compressibility at very high temperatures, accurately enough to verify new theories. The real promise of these experiments lies in the prospect of much greater laser energy available to compress targets with the National Ignition Facility.

Through our combined theoretical, experimental, and computational approach, we have been able to solve some of our major, long standing unknowns about weapon performance that had remained unresolved by past nuclear testing. The solutions uncovered new connections between phenomena previously not recognized as being related and these unexpected connections have enabled us to solve additional problems. Although much more needs to be achieved, we are making significant progress toward the goal of understanding, at a fundamental level, more about the systematics of the nuclear-test performance of stockpile weapons.

Stewardship Accomplishments—in Assessment and Certification

Assessments of the performance of stockpiled weapons and modification actions must be demonstration-based—that is, grounded on existing nuclear test data, component-level experiments and demonstration, and simulations using detailed, calibrated computer models. We are engaged in a balanced and integrated program of computational simulation, fundamental scientific research, and experiments. Nonnuclear experiments are used to assess weapon component performance. Together with past nuclear test results, they also are used to validate computer simulations, which rely heavily on fundamental scientific research as a source of data and a basis for the detailed physics models in the codes. Once validated to the extent possible, weapon physics simulations guide our judgment about integral stockpile issues.

In many stockpile stewardship activities this year, we have successfully combined past nuclear test data and nonnuclear experimental results with our most sophisticated computer models and advances in theory to attain a solid scientific foundation for our assessments. I have already briefly mentioned annual certification of the stockpile and dual revalidation, a very thorough multiyear evaluation of each weapon in the enduring stockpile. Dual revalidation of the Los Alamos W76 warhead, the first system examined, is now in the second year of the process. Each laboratory is taking novel—and at times, very ingenious—experimental approaches to examine specific issues and using its own computer models for assessment. We are greatly encouraged by the intellectual vigor of the independent assessment approach, as well as the high level of interlaboratory cooperation and data sharing the process is fostering. Demonstration-based assessments also underpin Livermore's W87 stockpile life extension work, which is discussed later.

A Stockpile Issue Addressed Through Experiments and Modeling

A significant stockpile stewardship achievement in 1997 is the assessment and successful resolution of an issue that arose about a weapon in the stockpile. Aging led to a physical change—a perturbation in the system. The perturbation had the potential of disrupting performance during operation of the weapon. Each lab conducted an assessment of the issue. The work performed at Livermore is instructive of how we use experiments and computer models in assessments.

To evaluate the effect of perturbation, we needed to use the most sophisticated three-dimensional physics code we had, developed as part of the Accelerated Strategic Computing Initiative. At the same time, a very clever group of experimentalists devised a way to use the best laboratory capability we had available—the Nova laser—to create a similar set of conditions that could be scaled in a way to validate the code. In a set of carefully diagnosed experiments on Nova, we did precisely that, used the validated simulation code, and concluded that the perturbation would have no effect on weapon performance.

Through a different combination of simulation and experiments, Los Alamos independently came to the same assessment. Consequently, we concluded that we do not have a problem with the weapon system. However, had the perturbation been much larger, we would have had to model the behavior for a longer time in greater detail. That requires greater computing power. It also requires higher energy laser experiments to test and validate the simulation models to the necessary level of detail. More difficult assessment problems necessitate better tools, which are an important element of the Stockpile Stewardship Program.

The Accelerated Strategic Computing Initiative

The Accelerated Strategic Computing Initiative (ASCI) is a program to dramatically advance our ability to computationally simulate the performance of an aging stockpile and conditions affecting weapon safety. Although it will take in total more than a decade to achieve ASCI's long term goals—up to a millionfold increase in computer speed and data storage capacity—the initiative is designed to deliver significant new capabilities at a steady pace throughout the decade in support of stockpile stewardship. To make the needed major advances in weapons science and weapons simulation code technology, Livermore, Los Alamos, and Sandia national laboratories are obtaining from U.S. industry dramatic increases in computer performance and information management. The ASCI program is integrating the development of computer platforms, simulation applications, and data management technologies. At Livermore, we are benefiting from the success of ASCI to date in three principal ways.

First, we took delivery of the ASCI Blue Pacific computer from IBM in September 1996 and have been using it with great success. The 512-node "Initial Delivery System," the first of four major deliveries in the contract with IBM, nearly tripled Livermore's computing capability. ASCI Blue Pacific has already performed very detailed calculations of 3-D phenomena long suspected of having a major influence on weapon performance which simply could not be addressed prior to the ASCI program. In addition, simulations on the ASCI machine are helping to provide the basis for assessments for the W76 dual revalidation effort and the program to extend the lifetime of the W87. We have also used the enhanced computing power to study high-explosive safety issues, evaluate requirements for Inertial Confinement Fusion capsule manufacture, and greatly improve our understanding of the properties of plutonium and other materials. In addition, Blue Pacific provided a testbed to demonstrate that key algorithms in our weapon simulation codes are scalable—they will speed up as anticipated as we move from hundreds of parallel processors to thousands.

Second, we are on schedule to obtain at Livermore greatly enhanced computing capabilities. At the moment, IBM is in the process of upgrading Blue Pacific with faster processors, new software, and additional storage capability, which will increase the computing capability to 0.9 trillion operations per second (0.9 teraFLOPS). The upgrade paves the way for installation of the Sustained Stewardship TeraFLOPS (SST) machine in the Spring of 1999. SST will perform at 3.2 teraFLOPS and surpass ASCI Red at Sandia as the fastest and most capable machine in the world. In addition, as announced by Secretary of Energy Federico Peña in February, our contract with IBM has been extended to acquire the 10-teraFLOPS “Option White” supercomputer by the first quarter of 2000. Expansion of Livermore’s computing power beyond “Option White” will necessitate additional investment in Laboratory infrastructure to accommodate the capability.

ASCI’s goal of a 100-teraFLOPS computer requires further increases in capability and major efforts by industry to develop the technology to interconnect tens of thousands of advanced microprocessors. President Clinton’s announcement, also in February, of PathForward provides a big step toward a 100-teraFLOPS computer. PathForward contracts worth over $50 million over the next four years were awarded to Digital Equipment Corporation, IBM, Silicon Graphics Computer Systems (SGI/Cray), and Sun Microsystems.

Third, the expansion of ASCI to include academic partners provides the Laboratory both near- and long-term benefits. ASCI’s Academic Strategic Alliances Program (ASAP) aims to establish large-scale computational simulation as a viable methodology in science and engineering and to accelerate advances in key technology areas. In July 1997, ASAP awarded funds to establish centers at five universities: California Institute of Technology, the University of Chicago, the University of Illinois/Champaign, Stanford University, and the University of Utah/Salt Lake. Livermore scientists are interacting with these centers, which are focused on the development of advanced physics and engineering simulations related to important stockpile issues. More generally, we will benefit from a strengthening of U.S. academic programs in high-performance scientific computing and closer ties with universities, which provide a major source of new talent for the Laboratory.

The National Ignition Facility

Construction is under way at Livermore of the National Ignition Facility (NIF), a $1.2 billion facility housing a 192-beam laser and associated experimental capabilities. The NIF is a cornerstone of the Stockpile Stewardship Program. It will be the only facility capable of well-diagnosed experiments to examine fusion burn and study the thermonuclear properties of primaries and secondaries in nuclear weapons. Advanced computer models being developed for stockpile stewardship need to be tested in the physical conditions that only the NIF can provide.

In March 1997, the multilaboratory NIF design team from Livermore, Los Alamos, Sandia and the University of Rochester achieved Critical Decision 3, based upon the successful completion of the NIF Title I Design. DOE approved the start of construction and procurement for the NIF. Groundbreaking for the research facility, which will be by far the world's largest laser, occurred in May 1997. I am pleased to report that—in spite of record el Niño rains and the discovery and recovery of 10,000 year-old mammoth bones during excavation—NIF construction is on budget and on schedule for completion in 2003. The NIF is proving to be a mammoth undertaking in more ways than one.

If you had visited the Livermore site in January, you would have seen a very large hole in the ground—the start of facility construction. This month you would see concrete structures such as footings and columns for the laser building; next year you will see the completed building frame. In less than four years from now, there will be a football-stadium-size, state-of-the-art laser facility already contributing to stockpile stewardship. The last of the major building construction contracts is to be awarded this month. I am please to report that due, in large measure, to the risk mitigation program undertaken by the project team, including such elements as a Project Labor Agreement and Owner Controlled Insurance, all conventional contracts awarded have been at or below the project estimates for cost. Procurement of special equipment has also begun, building on critically important partnerships forged with U.S. industries to ensure that equipment based on the advanced technologies needed for the NIF can be delivered on budget on time.

In particular, techniques are being developed in partnership with industry to mass produce and assure the production quality of large-aperture, high-precision optical components. Enabling technology advances range from methods for rapid growth of superior quality crystals that weigh over 500 pounds to interferometers that can measure the accuracy of optical surfaces to about the width of an atom. New production lines have been installed in companies in Fremont, CA, and Duryea, PA, that will mass produce at very reasonable cost the large, high-precision laser glass needed for the NIF project. More generally, with about 75% of funding planned to go to industry, the NIF project is also broadly affecting companies involved in integrated-circuit manufacturing, computer controls, diagnostics, power system components, high-voltage technology, high-speed digital transmission, and precision parts fabrication. The new technologies and processes being developed will be available to our industrial partners for a wide range of commercial uses after NIF needs are met.

We are partnering with the French on laser technology underpinning our respective projects in a way that reduces the risk of technological problems for future lasers. The French are currently constructing an 8 beam laser and planning larger systems with technology similar to that of our NIF. Our partnership has been critical to establishing and meeting the goals for both nation's laser projects. The British are also considering a new high-power laser for stewardship and science applications. We are likely to cooperate with them on specific laser technology if they choose to construct a new laser.

Through your support, nearly 42% of the total funding for the NIF project has already been authorized. To keep the NIF on schedule and within cost, $284.2 million in construction funds needs to be obligated in FY 1999. In addition, $6.8 million in operating funds (included in the Inertial Confinement Fusion Program request) are needed. In terms of overall budget, nearly 66% of the funds will be committed by the end of FY 1999. The NIF schedule calls for an initial capability by the end of 2001. Weapon physics experiments will be conducted using the first bundle of 8 laser beams to be installed, which will provide a capability equivalent to approximately twice that of Nova. Half of the 192 beams will be available for use in experiments at the end of 2002 and project completion is scheduled for the end of 2003.

We are very much looking forward to the opportunity to use the NIF to achieve fusion ignition and burn in a controlled laboratory setting. To succeed will be both a remarkable achievement and meaningful indicator that stockpile stewardship is working. Like the design of a nuclear weapon, fusion in the laboratory is an integral experiment that tests the skills and resourcefulness of the physicists and engineers who will be the nation's stockpile stewards in the future. Success in fusion experiments will also greatly boost the value of the NIF as tool for laboratory experiments to address real stockpile problems and study the physics of nuclear weapon primaries as well as secondaries.

Stewardship Accomplishments—in Stockpile Refurbishment

Livermore is the design laboratory for four weapon systems in the planned stockpile: the W87 and W62 ICBM warheads, the B83 bomb, and the W84 cruise missile warhead. They are expected to remain in the stockpile well past their originally anticipated lifetimes; the W62 already has. We are developing comprehensive plans to extend the stockpile life of the Livermore-designed systems. To this end, significant effort is being expended on their surveillance, maintenance, and selective refurbishment.

W87 Life Extension Program

The objective of Livermore's W87 Life Extension Program (LEP) is to enhance the structural integrity of the warhead so that it may remain part of the enduring stockpile beyond the year 2025 and will meet anticipated future requirements for the system. The W87 warhead/Mk-21 reentry vehicle (RV) is a candidate for a single RV option for the Minuteman III ICBM. It is the most modern and safe U.S. nuclear warhead. It incorporates the most modern safety features: Insensitive High Explosive, a Fire Resistant Pit, and an Enhanced Nuclear Detonation Safety architecture.

The W87 LEP is on schedule. We are well along in development activities, which have included flight testing, ground testing, and physics and engineering analysis. In 1997, we achieved a major milestone with the release of the W87 life extension design to the DOE production agencies. While the production agencies are readying for the stockpile refurbishment, final assessment testing and analysis of the design will be completed. We will also be certifying product processes in 1998. The first production unit is scheduled to be completed in February 1999 and the final production unit in 2003.

We are establishing new precedents and procedures with the W87 LEP, which is the first of what promises to be a series of life extension activities within the Stockpile Stewardship Program. In many respects, the program is being managed the way advanced development programs had been managed in the past for new warhead designs. Activities are being coordinated by a Joint DoD/DOE Working Group under the direction of the Nuclear Weapons Council. What is different in this case—in the absence of nuclear testing—is the very extensive technical review process that has been established to certify the design changes. It is to be a three-tiered review process. First, Livermore will conduct an internal review leading to a W87 Final Weapon Development Report, which will be the certification document. Second, DOE will conduct a review, which will include peer review reports prepared by Los Alamos and Sandia. Finally, DoD will conduct its technical reviews, managed by the Project Officers Group, before acceptance of the weapon to the stockpile.

Advanced Design and Production Technologies

As part of the Advanced Design and Production Technologies (ADaPT) initiative, the Laboratory is teaming with the plants to develop and provide greatly improved manufacturing technologies for stockpile refurbishment and life extension of weapon systems. We see major opportunities to introduce advanced manufacturing technology, improve production yields, and greatly lower costs in the long run. As part of our commitment, we have signed cooperative agreements with Savannah River and Pantex to develop and transfer technologies in areas of mutual interest more efficiently. We are also forging partnerships on production issues with the Y-12 and Kansas City plants, and we are working with TA-55 at Los Alamos on plutonium-part production technologies that reduce cost, hazardous waste generation, and radiation exposure to workers.

One area of continuing interest and considerable progress in 1997 is the use of an ultra-short-pulse laser for precision cutting. The technology, which earned an R&D 100 Award in 1997, originated in the Inertial Confinement Fusion program at Livermore and was further developed through Laboratory-Directed Research and Development funding. In 1996, working with personnel from Y-12, we demonstrated the feasibility using lasers to cut high-value parts in the W87 warhead. Efforts are continuing to design and build a production-worthy Laser Cutting Workstation for the Y-12 plant, which will have general applicability to several stockpile systems and refurbishment programs.

During 1997, we also demonstrated for the first time use of the laser system as a safe and precise way for cutting high-explosive materials. With its ultrashort pulse, the laser does not heat materials as it cuts, so it minimizes the amount of material lost and damage to surrounding material in the cutting operation. Pantex is very interested in further development of laser cutting for high-explosive applications. In addition, we are working with the Pantex Plant to establish a pilot production capability for TATB, the explosive ingredient used in stockpiled weapons with insensitive high explosives. Developed by Laboratory researchers, the production process is based on an entirely new synthesis route that avoids producing chlorinated compounds dangerous to the ozone layer.

Finally, to foster greater integration of work throughout the nuclear weapons complex, we are developing a complexwide, secure, high-speed digital network. In effect, it will be a “Secure Internet” with classified information shared on a need-to-know basis. Initial implementation of the system allowed Livermore to ship over 2000 classified documents to Y-12 for use in the W87 life extension program, saving time and reducing costs.

Stewardship Accomplishments—in Meeting Broader Defense Needs

The three DOE national security laboratories (Livermore, Los Alamos, and Sandia also work effectively with the Department of Defense (DoD) to leverage the laboratories’ capabilities and provide long-term research and development support to meet future defense challenges. Livermore has a history of making technological advances in many areas, such as missile defense, solid-state lasers, armor/anti-armor materials and munitions, conflict simulation modeling, and miniturized sensors.

In particular, in addition to nonproliferation efforts discussed in the next section, we have been engaged for over a decade in a DOE/DoD advanced conventional munitions technologies program with the Services and the Office of the Secretary of Defense. At Livermore, major focuses of this program have been the formulation of new energetic materials and the development of computer tools for design and analysis. For example, the Livermore-developed high explosive, LX-14, is now used in the TOW and Hellfire missiles. Our Cheetah code is widely used both to predict the performance of propellants and explosives and to evaluate formulations of new energetic materials. In addition, in this past year, the Laboratory developed and applied for the first time a first-principles, three-dimensional computer code to the evaluation of the safety of conventional munitions in a fire accident scenario.

The laboratories are currently working to establish ways to further increase the effectiveness of the support provided to the DoD and make it even more responsive to critical needs. In particular, in response to FY 1998 Congressional authorization language, we are helping to prepare a pilot proposal for a hard and deeply buried target defeat program that would facilitate effective teaming between the DOE laboratories, DoD, and defense industry to meet important military needs in this area.

STEMMING THE PROLIFERATION OF WEAPONS OF MASS DESTRUCTION

The proliferation and potential use of nuclear, chemical, and biological weapons (collectively referred to as weapons of mass destruction, or WMD) threatens the security of the nation and indeed the world. As Secretary of Defense William Cohen has said, “the proliferation of weapons of mass destruction presents the gravest threat that the world has ever known.”

The revelations of Iraq’s extensive and previously undetected efforts to develop nuclear weapons brought the threat of WMD proliferation to center stage in the global security arena. At least 20 countries, some of them hostile to the U.S., are suspected of or known to be developing WMD. In addition, the increasing potential availability of WMD materials (for example, nuclear materials from dismantled Soviet weapons) and WMD know-how (for example, through the Internet) makes terrorist acquisition of such weapons frighteningly possible.

Livermore’s Nonproliferation Program

Livermore is applying its nuclear expertise, developed through its past work in nuclear weapon development and testing and through its continuing stockpile stewardship responsibilities, to the challenge of nonproliferation. Our program in nonproliferation, arms control, and international security is tackling the problem of WMD proliferation across the entire spectrum of the threat. We are involved in activities to prevent proliferation at the source, to detect and reverse proliferant activities, and to counter WMD terrorism.

Because the threat of proliferation is not restricted to nuclear weapons and in response to recent legislation calling for enhanced U.S. capabilities against WMD proliferation, we are also developing the technologies, analysis, and expertise needed to help stem the proliferation of chemical and biological weapons. These activities build on Livermore’s large investment in chemical and biological sciences. We have also established a Center for Global Security Research to bridge the gap between the technology and policy communities and explore ways in which technology can enhance international security.

Different approaches are needed to address the threats posed by the different “proliferation players.” Cooperative projects can be used to engage weapons states like Russia. However, as UNSCOM’s difficulties in Iraq demonstrate, face-to-face cooperation is unlikely or unfeasible with suspected proliferants, and effective remote monitoring technologies are clearly needed. The detection challenge is even greater with terrorists, thereby placing a premium on rapid identification and response technologies.

Preventing Proliferation at the Source

Proliferation is most effectively halted at the source—of weapons-usable nuclear materials, of weapons-related technology, and of WMD expertise. We are working with the republics of the former Soviet Union in numerous activities to secure weapons-usable nuclear materials and to prevent the spread of WMD technologies and expertise from these states.

Fissile Materials Security in the Former Soviet Union

As a nuclear superpower, the Soviet Union produced and stockpiled enormous quantities of weapons-grade nuclear materials. The security of weapons-usable fissile materials stored within a vast complex of civilian and defense industrial facilities in the republics of the former Soviet Union (FSU) represents one of the most immediate challenges for preventing nuclear weapons proliferation. Diversion of these materials poses the greatest threat for rapid development of nuclear devices by rogue proliferant states or subnational groups.

Livermore's contributions to U.S. efforts to resolve this issue include detailed assessments of the forms, quantities, and security status of weapons-usable materials and specific facilities, together with collaborative activities with FSU organizations to enhance their nuclear material protection, control, and accounting (MPC&A). Through this dual-track approach, we are learning about the particular problems faced by officials within the FSU, implementing MPC&A upgrades throughout the FSU, and reducing our levels of uncertainty about the magnitude of the problem.

Protection, Control, and Accounting of Nuclear Materials

The economic and infrastructure changes that have resulted since the breakup of the Soviet Union cast doubt on the ability of existing controls to keep this nuclear material from falling into the hands of potential proliferants. We continue to collaborate with research and manufacturing facilities in the former Soviet Union to upgrade the protection, control, and accounting of nuclear weapons materials stored or processed at those sites. This work, part of the DOE's Material Protection, Control, and Accounting (MPC&A) program, represents a major U.S. effort to reduce the potential for unauthorized transfer or theft of nuclear materials from the numerous stockpile sites within the former Soviet Union.

MPC&A activities are progressing with all 53 known sites in Russia and the other republics of the former Soviet Union. Among the MPC&A projects at Livermore is work with the Pulse Research Reactor site at Chelyabinsk-70, one of the former Soviet nuclear weapons design laboratories. This year, we completed the physical protection and computer accounting upgrades, and a commissioning ceremony is scheduled for May 1998.

We are also working with the Northern and Pacific fleets of the Russian navy and the Murmansk Shipping Company to enhance the protection of fresh, highly enriched reactor fuel for their nuclear-powered vessels. This work involves direct interactions with the Russian Ministry of Defense. For the Murmansk icebreaker fleet and the Northern naval fleet, we have completed site characterizations, defined the necessary upgrades, and are in the implementation phase. For the Pacific naval fleet, we are starting site characterization and anticipate that we will begin implementation of upgrades by the end of the year.

Plutonium Immobilization

Another critical element in fissile materials security is the irretrievable disposition of weapons-grade nuclear materials from dismantled U.S. and Russian weapons. As part of a bilateral nuclear nonproliferation initiative, the U.S. and Russia are studying possible methods for disposing of stocks of surplus plutonium. In the U.S., the Office of Science and Technology Policy and the Department of Energy have the technical lead for these disposition studies. In its Record of Decision, announced in January 1997, the DOE recommended a dual-path approach of reactor burning and immobilization. Livermore is the lead laboratory for the technical development of the immobilization alternative (Oak Ridge has the lead for the reactor burning alternative).

In the immobilization approach, plutonium is encapsulated, together with fission products, inside glass or ceramic forms to decrease accessibility of the plutonium. The resulting material is sealed inside a stainless steel canister for emplacement in a geologic repository. We have developed, in conjunction with the Savannah River Site, the “can in canister” concept—an inexpensive, timely, and novel means for plutonium disposition. In this concept, plutonium is immobilized in glass or ceramic in small cans, which are then placed in large canisters and filled with molten high-level-waste glass.

Together with the Savannah River Site, the Argonne and Pacific Northwest national laboratories, several U.S. universities and industries, as well as research institutions in Australia and Russia, we conducted detailed studies of the immobilization approach. We defined compositions for the candidate glass and ceramic forms, characterized them for proliferation resistance and performance in a geologic repository, and developed the information needed to evaluate concepts for production processes.

A thorough review of the characteristics of the glass and ceramic immobilization forms was made by both a Technical Evaluation Panel (composed of experts drawn from the Plutonium Immobilization Program) and an independent Peer Review Panel. We concluded that the ceramic technology offers a number of important advantages over glass. Notably, the ceramic form is more robust to the threat of theft, diversion, or reuse; is expected to be significantly more durable in a geologic repository environment; and has a significantly lower radiation source term, reducing the potential for worker exposure during fabrication. In September 1997, Livermore’s recommendation of ceramic immobilization form was accepted by the DOE’s Office of Fissile Material Disposition.

The initial development, characterization, and evaluation of the immobilization waste forms are significant not only for the enormous amount of scientific and technical work involved but also for the fact that the work was completed 14 months earlier than the original program plan. In future work, we will focus on characterization, performance testing, and qualification of the ceramic form for repository disposal and on engineering development of the production process and equipment for the future plutonium immobilization plant.

Evaluating Foreign Nuclear Weapons Programs

The Administration’s commitment to a Comprehensive Test Ban Treaty (CTBT) has profoundly affected the way in which the U.S. maintains the safety and viability of its nuclear weapons stockpile, even as international arms-reduction processes strive to further reduce nuclear stockpiles worldwide. At Livermore, we have an ongoing effort to study the issues affecting the long-term maintenance of foreign nuclear weapons stockpiles. This research helps to elucidate important differences between the specific set of U.S. technical stockpile stewardship issues and the stockpile issues affecting other declared nuclear weapon states. Careful accounting for these differences can promote better understanding of activities observed at foreign test sites. This improved understanding can help resolve questions about these foreign nuclear weapons programs and about their governments’ level of commitment to international arms-control initiatives.

Detecting and Reversing Proliferants

As noted, at least 20 countries, some hostile to the U.S., are suspected of or known to be developing WMD. Indeed, the 1991 discovery of Iraq’s extensive and previously undetected efforts to develop nuclear weapons, and the continuing efforts to uncover and reverse Iraqi WMD activities, highlight the challenge of detecting proliferation activities.

Livermore strengths in advanced instrumentation and computational simulation are particularly valuable here. All proliferation activities leaves clues—chemical effluents, materiel movement, etc. We are collaborating with other DOE national laboratories in the development of novel multiwavelength and laser-based schemes that will make it possible to detect and identify trace amounts of chemicals at a distance. We have also developed a versatile and powerful modeling system for analyzing the proliferation activities of foreign countries and are developing a number of sensor systems for detecting clues to WMD proliferation from a distance.

Counterproliferation Analysis and Planning System (CAPS)

Our Counterproliferation Analysis and Planning System (CAPS) permits the analysis of proliferation activities of foreign countries and the evaluation of the consequences of possible interdiction options. These analyses provide valuable technical input to the decision-makers who must determine the U.S. response to detected proliferation activities.

CAPS has become an important contributor to the U.S. Strategic Command (STRATCOM) in its role supporting counterproliferation operational planning for major combatant commands throughout the U.S. armed forces. For example, in February 1998, STRATCOM called upon CAPS for an analysis of toxicity levels for a list of chemical and biological agents. This analysis was needed by U.S. military planners to evaluate the potential of collateral damage that could occur if the compounds were released to the environment. CAPS also supports counterproliferation exercises and planning by the U.S. Special Operations Command, the Air Force, and the Defense Intelligence Agency.

With CAPS, users can model the various chemical, biological, metallurgical and other processes that proliferators may be using to build weapons of mass destruction. Drawing on information from many sources, CAPS can generate models of a specific country's proliferation activities, helping to identify the function and location of suspected production sites. By modeling proliferation activities at this level of detail, users can analyze the country's specific approach to weapons production and identify critical processing steps or production facilities which, if denied, would prevent that country from acquiring weapons of mass destruction.

This past year, we augmented CAPS with demographic data and atmospheric plume models developed for Livermore's National Atmospheric Release Advisory Center (NARAC). This upgrade allows users to analyze collateral damage resulting from possible interdiction actions, including such socioeconomic and environmental consequences as civilian injuries, crop loss, and damage to water aquifers. We are also building a suite of chemical databases that will permit evaluation of the effects of industrial chemicals that could be released into the environment as the result of interdiction actions against proliferant sites.

Protecting Against WMD Terrorism and Chem/Bio Attacks

Terrorism using weapons of mass destruction poses a real and growing threat. Aum Shinrikyo, the terrorist group responsible for the sarin nerve gas attacks on the Tokyo subways, demonstrated with deadly clarity that technical barriers to terrorist acquisition of WMD can be breached. Ramzi Yousef, the mastermind of the World Trade Center bombing, had also considered the use of chemical weapons. The recent anthrax scare in Las Vegas highlighted the ready availability of biological materials and the reality of the biowarfare threat.

Biodetectors

DOE's program in Chemical and Biological Weapons Nonproliferation was initiated just over a year ago to apply the national laboratories' technical resources to the development of effective capabilities for dealing with the threat posed by chemical or biological weapons. Livermore is making significant contributions in the areas of systems analysis, detectors, bioinformation, plume prediction, and decontamination.

A limiting factor in the nation's ability to protect against a biological weapon attack is the current state of biodetector technology. At Livermore, we are developing two classes of biodetectors: immunofluorescence-based sensors (our MiniFlo cytometer) and DNA-recognition instruments (based on the polymerase chain reaction, or PCR). Our goal is to develop robust, autonomous biological agent detectors—a "sentinel" against biological attack.

The MiniFlo provides rapid and sensitive detection of both pathogens and toxins. We demonstrated our miniflow cytometer in 1996 at the Joint Field Trial (JFT) III held at Dugway, Utah. In this exercise, participating teams conducted 1600 analyses on 400 samples over a period of ten days in a field laboratory setting. Samples included four simulant materials representative of typical biological weapon materials as well as blanks and combinations of simulants.

MiniFlo had a near-perfect score at JFT III. It achieved a positive identification for 87% of the samples, with an exceptionally low "false positive" rate of only 0.4%. This level of successful identification was achieved for samples ranging over a factor of 1000 in concentration and at a very high rate of analysis (less than one minute per sample for flow cytometry). In the past year, we have modified this instrument to increase its sensitivity, accuracy, speed, and throughput.

A prototype of our mini-PCR instrument was demonstrated for the first time at the 1996 Dugway test. PCR instruments use DNA replication techniques (specifically, the polymerase chain reaction) to amplify minute samples of DNA and provide specific identification of individual organisms. Unlike typical laboratory PCR instruments, which are bulky and require large power sources, this first-generation mini-PCR fits inside a large suitcase, runs on batteries, and can be carried into the field and used for *in-situ* analyses.

At the 1997 Port/Airbase Advanced Concept Technology Demonstration (ACTD), we tested a new PCR instrument, the Automatic Nucleic Acid Analyzer (ANAA). Unlike the previous instrument, which can analyze only one sample at a time, ANAA can analyze multiple samples at a time. In addition, the new instrument does all the required sample preparation automatically, eliminating the need for a laboratory technician to prepare samples for analysis. This nearly autonomous multichamber PCR instrument was built and demonstrated in only seven months. At the Port/Airbase ACTD, the instrument successfully demonstrated autonomous operation from the point of a collected sample—that is, automatic sample preparation, PCR, and reporting of results. In addition, the ANAA withstood the challenge of significant quantities of known obscurants such as smokes and oils.

We also tested ANAA at the 1997 JFT IV. The results from this field test mark a significant milestone in the detection of pathogenic agents by PCR. The performance of our ANAA far surpassed expectations with respect to rapidity of analysis, number of samples analyzed, and reliability. More than 1200 PCR reactions, including both samples and controls, were analyzed at this field trial. Despite more than 90 hours of operating time, the instrument ran without a single mechanical or electrical problem. Results from the Port/Airbase ACTD and the JFT IV provide convincing evidence that PCR is indeed an effective technique for field identification of biological agents.

Joint Biological Remote Early Warning System (JBREWS)

The U.S. military is extremely concerned about the threat of a biological attack on U.S. troops. Indeed, the Department of Defense takes this threat so seriously that U.S. troops slated for deployment in the Middle East are being vaccinated against anthrax.

In a collaborative effort with the Joint Project Office for Bio-Defense and the Los Alamos National Laboratory, we are helping to develop a network of sensors and communication assets to provide U.S. troops in the field with early warning of a biological attack. With sufficient warning, military personnel can don protective suits or masks before they receive heavy doses of biowarfare agents released in the area.

The Joint Biological Remote Early Warning System (JBREWS) combines a network of commercially available sensors with the military's communications assets. By networking the sensors, JBREWS can optimize their overall performance. By tying into the military's existing communications system, JBREWS takes advantage of well-established command and communications procedures. JBREWS is portable and flexibly deployable to any and all locations where U.S. troops are deployed.

This past year, the JBREWS system architecture was designed. JBREWS is scheduled to be demonstrated in an Advanced Concept Technology Demonstration (ACTD) in 1998. For this ACTD, Livermore has responsibility for the JBREWS control system, networking, radiofrequency communications, and system operations.

Bridging the Technology–Policy Gap

Technical issues comprise only a portion of the nonproliferation and counterterrorism picture. Our Center for Global Security Research bridges the gap between the technology and policy communities, bringing technologists and policy people together to examine factors that can reduce the threat of weapons of mass destruction and identify ways in which technology can enhance the international security framework. The Center collaborates with a broad spectrum of organizations and has sponsored workshops and conferences on the role of technology in peacekeeping operations, possible monitoring regimes for the Biological Weapons Convention, and policy and technology implications in critical infrastructure protection. The Center has also supported studies of why countries do or do not choose to develop nuclear weapons and the political and technical issues in developing a systematic approach to sustainable humanitarian de-mining.

Critical Infrastructure Protection

With the growing reach of the Internet, there is increasing awareness of the reliance of U.S. society on critical infrastructures—frameworks of interdependent networks and systems that provide for the flow of goods, services, and information essential to the functioning of all levels of government and communities. Infrastructures critical to the defense or well being of the nation include electrical and power, gas and oil, telecommunications, banking and finance, transportation, water supply, and emergency services. In recognition of this dependency and attendant vulnerability, a President's Commission on Critical Infrastructure Protection was established in July 1996 to bring together the combined forces of government and industry to develop a strategy for protecting the nation's critical infrastructures and assuring their continued operation.

The Laboratory has contributed to this Presidential Commission through our Center for Global Security Research. Together with Stanford University's Center for International Security and Arms Control, we jointly sponsored a series of three workshops on critical infrastructure protection to assist the Commission in examining the issues of infrastructure vulnerability, potential threats, and possible remedies. These workshops also explored the impact on the marketplace of possible protective actions, costs in terms of capital and functionality, legal constraints, and the probable need for international cooperation. Participation at these workshops included members and staff of the Presidential Commission, the information technology industry, security specialists at infrastructure organizations as well as research companies and national laboratories, and the university community.

Critical infrastructure protection is one of a number of areas where national security requires a combination of policy and technology and a partnership between government and the private sector. By helping to facilitate these collaborations, our Center for Global Security Research provides yet another avenue for Livermore to carry out its national security mission.

INSTITUTIONAL ISSUES

The Technical Staff

The key to the Laboratory's contribution to the successes in stockpile stewardship and nonproliferation that I have reported is the technical staff at Livermore. Demanding responsibilities require top-notch people and their expert judgment. We rely on having highly qualified and experienced people that are motivated by the opportunity to do something important for the country, technical challenges in their careers, and access to the tools needed to get the job done.

We face the absolutely crucial challenge of maintaining expert judgment about nuclear weapons issues. This requires moving ahead with the Stockpile Stewardship Program as rapidly and completely as possible. It is a race against time. Inside the next decade our nuclear-test veterans will be gone. We are counting on our current cadre of experienced scientists to help develop and install the new tools only now starting to come on line. The experienced hands are working with their successors—both training them and evaluating their skills. Activities such as dual revalidation, weapon physics code development, and life extension programs are both crucial to immediate stockpile needs and an opportunity for training. Evaluations of these mentoring efforts are an integral part of the program's self assessment of the people and their capabilities in implementing the program.

Our important mission and significant technical challenges—together with the tools to meet those challenges—create real excitement and a strong sense of purpose at our Laboratory. I am optimistic that Livermore will be able to attract and retain the talent the nation needs to combat proliferation and terrorism and maintain stockpile safety and reliability in the early 21st century. Yet, this is a matter that needs continuing attention.

University of California Management of the Laboratory

I am pleased that the University of California (UC) continues to be the contractor operating Livermore, Los Alamos, and Berkeley national laboratories. This arrangement has provided great benefit to our Laboratory and the nation. It has been a major factor in attracting and maintaining a high-quality workforce and it has led to an array of scientific and technical associations that would have not been achievable otherwise. We also draw great benefit from the UC President's Council on the National Laboratories, which oversees the scientific work performed at the laboratories UC manages. The National Security Panel of the President's Council in particular has had a major impact on the direction and implementation of the Stockpile Stewardship Program.

We are also drawing benefit from the performance-based management provisions in the DOE/UC contract. As you may be aware, in 1997 the DOE/UC partnership to operate the national laboratories was identified as an exemplary model of performance-based management in a report prepared for Vice President Gore's National Performance Review. At Livermore, we are working within our performance-based management framework to improve the way we conduct laboratory business and reduce costs. In addition, we are working on management and oversight issues through Department-wide efforts and various pilot projects aimed at streamlining excessive DOE rules and regulations and consolidating laboratory audits and reviews.

SUMMARY REMARKS

The Stockpile Stewardship Program is off to a good start. It has greatly benefited from strong bipartisan support, effective integrated program planning and implementation, and the dedicated efforts of the many people in the program, who are working as a team and achieving significant technical accomplishments. We have formulated and started executing detailed program implementation plans. We have formed strong partnerships among the laboratories, the production facilities, the Nevada Test Site, and U.S. industry. And, we have established new formal certification procedures and review processes to assure the nation that the stockpile remains safe and reliable. The Secretaries of Energy and Defense provided such assurances in the first and second annual certifications.

A lot of technical work backs up the annual certifications and prepares us for a future in which stockpile assurance will become an even greater challenge in the absence of nuclear testing. We can point to many specific recent accomplishments: considerable headway in developing a basis for understanding aging effects in weapon materials, effective use of the computational and experimental tools we have in addressing current stockpile issues, and excellent progress in the program to extend the stockpile life of the W87 warhead. Furthermore, we are proceeding on schedule with the construction of the National Ignition Facility and the acquisition of more powerful computers needed to assess weapon performance and train the next generation of stockpile stewards.

The greatest challenges still lie ahead. The demands on the Stockpile Stewardship Program will grow as weapons in the enduring stockpile continue to age. The U.S. nuclear weapons stockpile is now older on average than it has ever been. The reservoir of nuclear test and design experience at the laboratories continues to diminish. Program success depends on bringing into operation scientific capabilities such as ASCI and NIF while there remain experienced nuclear designers to train the next generation of stockpile stewards. Maintenance of a safe and reliable nuclear weapons stockpile requires sustained bipartisan support for the program from Congress and the Administration. Accordingly, I urge your strong support of the FY 1999 budget submission for Defense Programs.

I also urge your vigorous support for the program proposed by the Office of Nonproliferation and National Security and for the programs and initiatives of other agencies in the area of WMD nonproliferation and counterterrorism. The enormity of the challenge cannot be overstated. In February, the U.S. and other nations almost took military action against Saddam Hussein on account of his denial of access for U.N. inspectors and the WMD threat he poses to the region. In the same month, the anthrax scare in Las Vegas (which, fortunately, was not a terrorist threat) highlighted the very real nature of the threat of WMD terrorism.

The proliferation of weapons of mass destruction can only be halted through a complex integration of technology and policy across the entire spectrum of the threat—the sources of weapons materials, technology, and expertise, the potential proliferators, and the rogue states and terrorists. As I have highlighted, Livermore is making significant progress in technologies to secure weapons-usable fissile materials, to detect the development of nuclear, chemical, or biological weapons, and to respond to proliferation threats and WMD incidents. The DOE program for FY 1999 includes increased support for an enhanced nuclear smuggling terrorism initiative, fissile materials disposition, and chemical and biological agent detection. We are prepared to make even greater contributions to the nation’s efforts to halt WMD proliferation and counter WMD terrorism.